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ABSTRACT

This executive summary of a research synthesis on effective teaching principles notes current trends in effective teaching research and educational reform and finds that research from both teacher-centered and student-centered paradigms have substantial empirical support. Descriptions are then provided of 10 teaching principles identified as effective, including a summary of the research and limitations and barriers for each. The principles are: (1) students learn more when engaged actively in an instructional task; (2) high and moderate success rates correlate positively with student learning outcomes; (3) increased opportunity to learn content is correlated positively with increased student achievement; (4) students learn more when they are being directly taught or supervised by a teacher; (5) deliberate and careful scaffolding of instruction helps students become independent learners; (6) critical forms of knowledge that must be addressed are declarative knowledge, procedural knowledge, and conditional knowledge; (7) instruction in organizing, storing, and retrieving knowledge increases learning; (8) strategic instruction helps students become more independent, self-regulated learners; (9) explicit instruction also helps achieve this goal; and (10) the teaching of sameness within and across subjects promotes students' ability to access knowledge in novel problem-solving situations. (DB)

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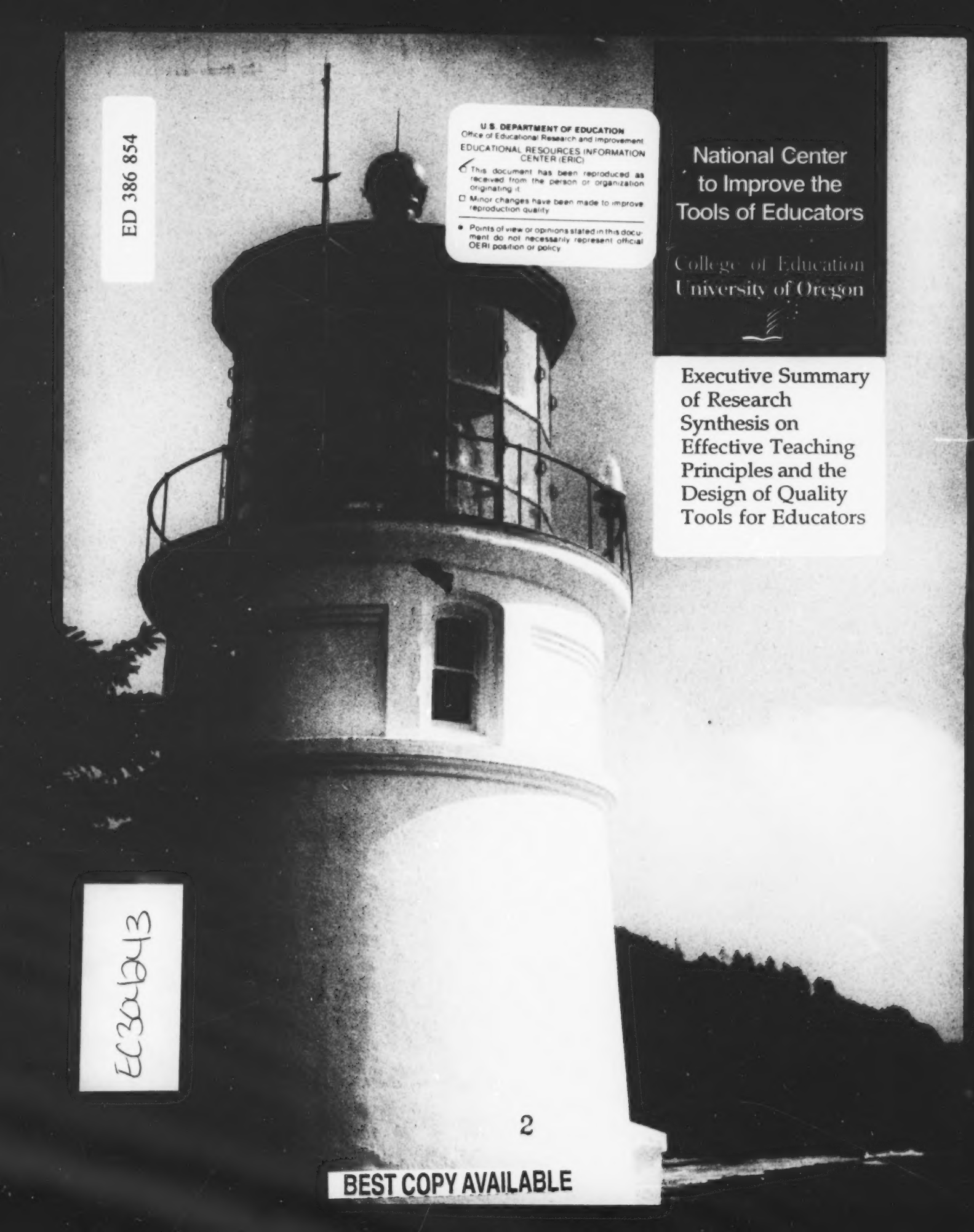

National Center to Improve the Tools of Educators

College of Education
University of Oregon

Executive Summary of Research Synthesis on Effective Teaching Principles and the Design of Quality Tools for Educators

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Executive Summary of Research Synthesis on Effective Teaching Principles and the Design of Quality Tools for Educators

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Executive Summary

Effective Teaching Principles and the Design of Quality Tools for Educators

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RUNNING HEAD: Effective Teaching

Effective Teaching Principles and the Design of Quality Tools for Educators

Effective teaching and effective student learning have been a central focus of current educational reform movements. We have witnessed a series of reform attempts through the publication of commissioned reports such as *A Nation at Risk*, (National Commission on Excellence in Education, 1983). More recently, we have heard about *Goals 2000: Educate America Act* as a framework for meeting the National Education Goals for all students. Given the intensity and frequency of discussions about the need for reform, we are faced with the assumption that educators in the United States "aren't doing enough."

It is with *quality* teaching in mind that we review and attempt to consolidate empirically-supported effective teaching principles from diverse theories (behavioral, cognitive, social-learning, etc.). Research has identified numerous broad-based principles that characterize current knowledge about effective teaching. We encourage readers not to interpret these principles as "dictums" for educators to follow, but to use them as guides to either confirm or disconfirm personal beliefs about teaching (Fenstermacher, 1980). Berliner (1988) noted it is the teacher who is the final arbiter of instruction. The teacher, as a reflective decision-maker, literally *is* the bridge between research and practice.

Effective Teaching Research and Educational Reform

Consider the simple notion set forth by Jones, Palinscar, Ogle, and Carr (1987), "...a fundamental tenet of developing effective teaching methods is that instruction should reflect what is known about learning" (p. 3). Much of the effective teaching research conducted during the 1970s and 1980s was undertaken within a "process-product" approach (i.e., those *overt* teaching processes that increase student achievement) (Bryan, Bay, Sheldon, & Simon,1990). For example, in the Beginning Teaching Evaluation Study, the focus was to identify and describe observable teacher variables related to student achievement such as student engagement time, student-teacher interactions, grouping arrangements, content coverage, etc. (Powell, 1980).

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More recent research has focused on the *internal* processes involved in student learning (e.g., the teaching of thinking) and how those processes are mediated by students and teachers. Given these new understandings of the teaching and learning process, efforts to reform education seem timely. Inherent in reform is the notion that some things will be changed but change should occur through careful analysis of our knowledge from empirical research about what does and does not work. We clearly should not abandon instructional techniques that are well grounded both theoretically and empirically. House (1991) noted that we need to engage in "informed reform."

Advances in research in cognitive and social science and student self-regulatory learning have led to numerous new "student-centered" instructional models (e.g., whole-language instruction, reciprocal teaching, cooperative learning, etc.). Unfortunately, many educators seem to view teacher-centered and student-centered paradigms as mutually incompatible - - that is, one must adopt either a teacher-centered behavioral approach or a student-centered cognitive approach. Our contention is that both behaviorist and cognitive theories have much to contribute in terms of effective teaching and learning. *Research from both approaches have substantial empirical support,* and our research reflects an admixture of both.

Overview of the Effective Teaching Principles

This section of the paper is designed to provide an in-depth review of ten areas of research on effective teaching (see next page for an overview). The order of the principles are loosely hierarchical in nature. That is, principles were organized so that concepts, terms, etc. generally build upon one another. Principles are presented in a self-contained fashion to permit a more coherent organization of the paper although the content of some principles overlaps at times. Each effective teaching principle is divided into the following sections.

A. Research

Generally, this section provides a review of research that supports the principle. Embedded within the overview are illustrations of specific instructional techniques and methods based upon the principle.

B. Limitations and Barriers

In each review of effective teaching principles, potential limitations and barriers are identified. Essentially, this section addresses those potential barriers that could prevent the bridging of research and practice.

Note: A comprehensive list of references is provided at the conclusion of this paper.

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Effective Teaching Principles

Principle 1: ***Students learn more when they are engaged actively during an instructional task.***

Principle 2: ***High and moderate success rates are correlated positively with student learning outcomes, and low success rates are correlated negatively with student learning outcomes.***

Principle 3: ***Increased opportunity to learn content is correlated positively with increased student achievement. Therefore, the more content covered, the greater the potential for student learning.***

Principle 4: ***Students achieve more in classes in which they spend much of their time being directly taught or supervised by their teacher.***

Principle 5: ***Students can become independent, self-regulated learners through instruction that is deliberately and carefully scaffolded.***

Principle 6: ***The critical forms of knowledge associated with strategic learning are (a) declarative knowledge, (b) procedural knowledge, and (c) conditional knowledge. Each of these must be addressed if students are to become independent, self-regulated learners.***

Principle 7: ***Learning is increased when teaching is presented in a manner that assists students in organizing, storing, and retrieving knowledge.***

Principle 8: ***Students can become more independent, self-regulated learners through strategic instruction.***

Principle 9: ***Students can become independent, self-regulated learners through instruction that is explicit.***

Principle 10: ***By teaching sameness both within and across subjects, teachers promote the ability of students to access potentially relevant knowledge in novel problem-solving situations.***

Engagement Time

Principle 1: ***Students learn more when they are engaged actively during an instructional task.***

Research

When planning instructional activities, time should be considered as an important instructional variable.

- Three aspects of time that directly impact student learning include: (a) the maximum amount of time that is allocated for the activity; (b) the degree to which students are engaged during allocated time; and (c) the degree to which the students engage in the activity at a high rate of success (Beginning Teacher Evaluation Study (BTES) in Denham & Lieberman,1980; Fisher, Marliane, Cahen, Dishaw, Moore, & Berliner,1980).

- The amount of allocated time devoted to specific content varies considerably from classroom to classroom. Average student engagement rates during an instructional activity are 60% to 75% but may range from 30% to 90% (cf., Kindsvatter, Wilen, & Ishler, 1988).

- High, moderate, and low success rates have a differential impact on student learning. When students are provided with high rates of success during instructional activities, the potential for student learning is increased (BTES in Block,1980).

- Students appear to spend approximately two-thirds of their allocated time in seatwork activity, and one-third of their time is spent in direct instruction. Student task engagement rate appears to be increased when activities are directed actively by the teacher (BTES, in Rosenshine, 1980).

- Seatwork activities are usually meaningful, and task engagement during seatwork may be optimized when the teacher interacts substantively with students (BTES, in Rosenshine, 1980). When seatwork activity is excessive, student engagement may decrease (BTES, in Rosenshine, 1980; Rosenshine & Berliner, 1978).

- Teachers use allocated time differently. Research has suggested that effective teachers spend 15% less time on management and organization tasks, and 50% more time in interactive activities.

- Effective teachers organize their time so they can spend at least some time with the total group, in small groups, and with individuals (cf., Borg, 1980; cf., Kindsvatter, Wilen, & Ishler, 1988).

- Academic learning time (ALT) consisting of allocated time, engaged time, success rate, and the relationship of activity to outcome is a good predictor of effectiveness (Berliner, 1984).

- Carroll (1989) proposed that five basic factors account for variations in school achievement. Three of these can be expressed in terms of time: (1) aptitude refers to the amount of time a student needs to learn a given task, (2) opportunity is the amount of time allowed for learning, and (3) perseverance is the amount of time a student is willing to spend on learning. The other two factors are related to achievement: (4) if quality of instruction is less than optimal, more time is needed for learning, and (5) if the student is lacking in ability to understand instruction, the amount of time needed is increased. Thus, "the degree of learning or achievement is a function of the ratio of the time actually spent on learning to the time needed to learn" (p. 26).

Limitations/Barriers to Effective Use

1. Teachers may be limited in their ability to plan and control allocated time. Dictates from administrators may require that specific amounts of time be allocated by content area. Additionally, individual school district administrations may require that a specific amount of content be covered during the school year. Efforts to include teachers in the decision-making process regarding time allocations in school may help reduce these time limitations.

2. Teachers may be limited in their ability to control managerial and organizational tasks. Attendance and lunch reporting along with other paperwork activities may impede their efforts to control time. Administrators and teachers alike need to work collaboratively and creatively in preventing managerial tasks from intruding upon instructional time.

3. Environmental barriers (e.g., physical arrangement of the classroom) may preclude the provision of a variety of instructional methods (e.g., large, small, and individual groupings; class size may limit the extent to which teachers may assess and individually plan activities). Environmental barriers may be reduced when administrators and teachers collaboratively seek solutions to environmental barriers.

4. Matching students to appropriate activities requires specific education/training in assessment to determine student needs. Inservice education, along with preservice education, may need to be provided to enable teachers to implement a successful, effective assessment program.

5. Teachers may not have the expertise needed to implement substantive interaction (e.g., questioning and probing skills may be limited) and may need additional preparation in this area.

6. Teachers may need additional education in providing adaptive, individualized instruction. Such an approach necessitates that teachers be aware of, and implement effectively, methods and materials appropriate to the student's needs. Again, additional inservice may be needed to alleviate this potential barrier.

Levels of Success/ Success Rate

Principle 2: ***High and moderate success rates are correlated positively with student learning outcomes, and low success rates are correlated negatively with student learning outcomes.***

Research

When planning instruction, the rate of success at which a student completes a task should be considered as a critical instructional variable.

- High rates of success (and to a less certain extent, moderate rates) are positively related to learning outcomes and low success rates are negatively associated with student learning outcomes (Beginning Teacher Evaluation Study (BTES), in Fisher, Berliner, Filby, Marliave, Cohen, & Dishaw, 1980 and other studies (Anderson, Evertson, & Brophy, 1979; Block, 1970; cf., Englert, 1983; 1984a; 1984b; cf., Fisher, Marliave, & Filby, 1979; cf., Rieth & Everston, 1988; Kindsvatter, Wilen, & Ishler, 1988; cf., Powell, 1979)}. There is a considerable, positive relationship between high success rate and achievement.

All students can master a subject given sufficient time and appropriate instruction.

- Block argued that if our schools are to increase student learning, more direct and concentrated efforts toward providing "errorless" learning should be undertaken. This principle, explicit in Bloom's (1968) mastery learning approach, necessitates that teachers routinely engage in the following activities: (a) diagnosis; (b) prediction, (c) orientation, (d) feedback, and (e) correction (BTES, in Block, 1980; Hudson, Colson & Braxdale, 1984).

- A careful content match between student level of achievement and task assignment appears essential if high student success rates, and thereby improved learning outcomes, are to occur (Adelman & Taylor, 1983; Brookover, Beady, Flood, Schweitzer & Wisenbaker, 1979). Brophy (1979) and Rosenshine (1983) reviewed numerous studies which indicated that academic tasks that are individualized according to student needs result in high success rates. In general, they concluded, effective teachers: (a) move students at a brisk pace; (b) present content in small steps; and (c) provide academic tasks that are mastered easily by most students.

- The range of success within a classroom may vary considerably. Results from the BTES (Fisher et al., 1980; cf., Berliner, 1988) indicated that student success rates in second-grade reading ranged from 9% to 88% or more on correct task completion. Similar success rates in math classrooms were observed by Squires, Huitt, and Segars (1983).

Research (continued)

- No data supports absolute percentages for high and moderate rates of success (Reith & Evertson, 1988), but Levin and Long (1981) recommended that a 70% to 80% success rate is acceptable *if* a student has achieved major content objectives. During independent activities, instructional tasks should promote even higher success rates (i.e., 90% - 100%).

- Younger and ineffective learners need to engage in tasks at a success rate that results in overlearning (Rosenshine,1983). He emphasized that basic skill acquisition is taught hierarchically, and consequently, success at any level requires application and knowledge of the skills previously learned.

- Students with mild disabilities may be exposed to content that results in low success rates. Students with mild disabilities may require more precise and continuous assessment of academic skills in order to increase the potential for high success rate (Reith and Evertson,1988).

- Successful experiences on tasks positively relates to increased academic achievement and internalized student attributions of success (e.g., personal ability and effort) (Anderson, Stevens, Prawat, & Nickerson, 1988; Aponik & Dembo, 1983; cf., Dweck & Goetz, 1978; Frieze & Weiner, 1971; Jacobsen, Lowery, & DuCette, 1986; Stipek, 1988). Students who experience frequent failure tend to attribute their success to other external factors (e.g., luck, task ease), may over a period of time exhibit behavioral characteristics associated with "learned helplessness", and may engage in task avoidance behavior (Adelman & Taylor, 1983; Thomas & Pashley, 1982).

Limitations/Barriers to Effective Use

1. *Administrative Barriers*

Pressure placed on administrators for both higher standards and minimum competency testing may prohibit the provision of content that promotes high student success rate and levels of task engagement. Administrative directives may place pressure on teachers to cover content that may not be conducive to the realization of high rates of student success. Such pressures may result in administrative decisions that prevent teachers from planning and implementing curricular activities appropriate to the individual needs of their students. Collaborative efforts among administrators and educators to provide both the time and human resources need to be addressed if this barrier is to be eliminated.

2. *Environmental Barriers*

Environmental barriers that may prohibit high student success rates include instructional grouping arrangements (e.g., ability grouping; large and small groups) and goal structures (e.g., competitive goal structures). The bulk of ability grouping research (Brophy & Good, 1970; Damico & Sparks, 1986; Dusek & Joseph, 1983; Eder, 1981; Epstein, 1980; Everston, Sanford, & Emmer, 1981; Eyler, Cook, & Ward, 1982; Femlee & Eder, 1983; Froman, 1981; Grant, 1984; Kimbrough & Hill, 1981; Kulik & Kulik, 1982; Rist, 1970; Rosenthal & Jacobson, 1968; Rowan & Miracle, 1983; Singleton, 1974; Weinstein, 1976) suggests that the social contexts that characterize low ability groupings are not conducive to student success. Such groupings appear to be contrary to research that supports the positive effects that well-planned heterogeneous groupings have on student achievement (cf., Worthington, Wortham, & Elliott, 1991).

Limitations/Barriers to Effective Use (continued)

Johnson, and Johnson (1987) identified three classroom goal structures: Cooperative, competitive, and individualistic. According to these authors, each of these goal structures influence the way students interact and the manner in which the teacher achieves an instructional goal. Competitive goal structures appear to be overused in many classrooms and may discourage high student success rates for some students (Anderson, Nelson, Fox, & Gruber, 1988; Johnson, Marruyama, Johnson, Nelson, & Skon, 1981). In contrast, research on the effects of cooperative learning techniques has been positive in terms of increasing motivation, but there is some indication that active learning may decline in some instances (Everston, 1974; cf. McCaslin & Good, 1992); Wang, 1979).

3. *Diverse Student Problem-Solving Styles*

Student problem-solving styles appear to be quite diverse. In a qualitative study, Anderson, Brubaker, Alleman-Brooks, and Duffy (1985) found that high-achieving students were more likely to be both attentive to, and successful on, daily tasks because they appear to use effective skills and strategies (e.g., talking through a task). Their narrative records also indicated that low achievers developed strategies for task completion that did not promote practice and learning the content (guessing, carelessness, attending to inappropriate contextual clues). As noted by Kronick (1988), effective learners also appear to be more successful because their flexibility of thought enables them to anticipate what the teacher might value in a finished product.

4. *Lack of Teacher Knowledge and Skills*

Teachers may lack the knowledge and skills to place students at an entry content level that will maximize student success (Hudson, Colson, & Braxdale, 1984). For example, readability formulas frequently used by teachers to match students with textbooks and the sole use of frequency to establish instructional aims have been questioned empirically (Lovitt, Horton, & Bergerud, 1987; Mercer, Mercer, & Evans, 1982). Additionally, the collection of precise student achievement data appears to be seldom undertaken, even among special education teachers (Cooke, Heward, Test, Spooner, & Courson, 1991; Fuchs, Fuchs, & Warren, 1982; Wesson, King, and Deno, 1984).

Content Coverage/ Opportunity to Learn

Principle 3: ***Increased opportunity to learn content is correlated positively with increased student achievement. Therefore, the more content covered, the greater the potential for student learning.***

Research

Providing students with ample opportunity to learn has been viewed by some as the single most important instructional principle derived from the effective teaching research (Barr, 1980; Cooley & Leinhardt, 1980; Rosenshine & Berliner, 1978).

- "Opportunity to learn" addresses the amount of coverage *actually* provided to students for *specific* academic content whereas "allocated time" examines the dimension of time *assigned* for *broad* content areas like reading and mathematics (Borg,1980). Simply stated, "... students tend to learn what they are taught and not to learn what they are not taught" (Powell, 1979; p.50). Results from the Beginning Teacher Evaluation Study ([BTES] in Block, 1980), have provided considerable support for the significant, positive relationship between opportunity to learn and student achievement.

- Husen (1967) has explained that content coverage variations across countries explain much of international achievement differences on tests. Morin (1986) maintained that curriculum development should occur within the contexts and needs of the community, school, and classroom.

Several variables appear to interact and impact substantially on both the amount and the quality of content coverage.

Curriculum Determination and Implementation

- Curriculum may be determined for teachers by school boards, administrators, curriculum publishers and communicated through curriculum guides, district-wide objectives, course syllabi etc. (Berliner, 1988; Kindsvatter, Wilen, & Ishler, 1988). Berliner (1988) noted, "The teacher is the final arbiter of what content gets taught" (p. 9).

- Brophy (1982), in his review of research conducted at the Institute for Research on Teaching (IRT) at Michigan State University, described two ways in which curriculum may be determined: (a) conscious decision-making by individuals in selecting the curriculum to be taught, and (b) reductions and distortions of the intended curriculum during the process of attempting to teach it.

- Several studies have indicated that teachers who enjoy teaching a specific content area are not only more likely to *teach* a specific content, but also more likely to spend more time teaching it (Brophy, 1982; Carew & Lightfoot, 1979); Schwille et al., 1981). Other teacher-decision making variables that may influence content coverage are (a) amount of time devoted to each topic, (b) topics to be covered; (c) students to be taught; (d) length of time and when each topic will be covered, and (e) the degree of student mastery required by each topic (Brophy, 1982).

Research (continued)

- There is some empirical evidence (cf., Brophy, 1982) that teachers may over-rely on published curriculum materials, particularly teacher guides and textbooks, to determine content coverage. Teachers may perceive themselves as curriculum implementers rather than active planners or decision-makers. Teacher failure to make purposes and objectives clear to students may result in a discrepancy between teachers' and students' perceptions regarding the meaning of the activities (Brophy, 1982).

- Effective teachers have high expectations for students, and place strong emphasis on the attainment of academic goals. Such classrooms are characterized by "high academic press". Increased student learning is associated with high academic press, but when a teacher places primary emphasis on affective outcomes rather than academic outcomes, student learning may decrease (BTES, Fisher, Berliner, Marliave, Cahen, & Dishaw, 1980).

- Stallings and Kaskowitz (1974) found that activities which had an *academic focus* (e.g., use of textbooks and other instructional materials) resulted in greater achievement than those that were less academic in nature (e.g., stories, arts and crafts, active play, toys, puzzles, even academic games).

- Wyne and Stuck (1982) identified several ways to increase students opportunity to respond: (a) beginning and ending lessons on time; (b) reducing transition time; (c) minimizing wasted time; and (d) monitoring students at all times.

Teacher Planning of Content

- Content coverage requires thoughtful decision making, particularly during the planning stage of instruction. Such decisions include determining student needs, assessing material level, analyzing the prerequisite knowledge acquired by students, and individualizing/evaluating the material covered (Kindsvatter, Wilen, & Ishler, 1988, p. 55). Effective teachers, according to Eggan and Kauchak (1988), *plan purposefully* for student learning, which requires a careful analysis of goals and thoughtful selection of appropriate content for students.

- Rosenshine (1983; 1986) indicated that effective teachers incorporate the following instructional sequence into their content lessons: (a) beginning the lesson with a short statement of goals; (b) reviewing previous learning; (c) presenting new material in small steps, allowing students practice time after each step; (d) giving clear and detailed instructions/explanations; (e) providing active and ample practice; (f) asking questions, checking for understanding, and obtaining responses from all students; (g) providing guided practice; (h) providing explicit instruction; and (i) providing practice for fluency attainment. Rosenshine emphasized that though these steps may not be appropriate for all learners, they are appropriate when material is new, difficult, hierarchical, or when students are young or experiencing learning difficulties.

Student Environmental Demands

- Ellis and Lenz (1990) expressed concern over limited learning opportunities that resource room students with mild learning disabilities experience in specific content areas (e.g., social studies, science). Students who have attended pull out programs in-lieu-of specific content area classes (e.g., resource rooms, compensatory programs) may be confronted with unique content learning problems. When these students are expected to master the same content as their general education peers, their prerequisite content-area knowledge may be quite limited. Over time, this discrepancy may continue to widen and become even more apparent in secondary settings. Schumaker and Deshler (1988) recommended that instruction in general education move from a teacher-centered to student-centered orientation to better meet the needs of these individuals.

Research (continued)

- Effective teachers have demonstrated an understanding of students' special characteristics and plan actively to meet students' needs. McCormick's (1979) study suggested that effective teachers (a) more often adapted instruction for students, (b) use ability- and age-appropriate vocabulary , (c) adjusted questioning levels to students' ability levels, and (d) made their presentations at an appropriate level of difficulty. Effective teachers also appear to plan enough time so that students can achieve content mastery before moving to new content (Clark, 1992; Gerber, 1986; Wang,. 1979).

Validity of the Tests used to Assess Content Mastery

- Decisions to use tests to measure content mastery must be made considering more traditional psychometric properties of the test(s) (e.g., adequate standardization, reliability, criterion-related validity, construct validity) and a careful review of the curriculum- and instructional-test match.

Limitations/Barriers to Effective Use

1. *Curriculum Determination and Implementation Barriers*

   Problems with curriculum reduction and distortion may be at least partially achieved when (a) teachers are involved in the development of curriculum, (b) careful monitoring of curriculum implementation occurs, (c) accountability procedures are provided to ensure that the curriculum content is systematically covered, and (d) educating all involved in curriculum development and implementation regarding those dynamic variables that impact upon content coverage. Significant barriers remain and draw into question how realistic it is for teachers to engage in these processes.

   The tendency for teachers to over-rely on published curriculum materials poses another barrier. Distortion and reductions can be eliminated by carefully reviewing materials prior to their selection to determine which cover curriculum goals and objectives, and are appropriate to learners' needs.

   Assisting teachers to develop high expectations for all students and incorporate activities into their classroom that are characterized as having an academic focus is central to eliminating barriers teachers have regarding expectations of students' achievement .

2. *Teacher Planning of Content*

   Though time for planning poses a significant barrier, teachers need specific instruction in "how to plan." Assisting teachers to incorporate into their plans strategies and techniques on how to increase student learning (e.g., communicating goals and objectives to students, asking frequent questions and providing corrective feedback) should be a central focus of such education.

3. *Student Environmental Demands*

   Proceeding to cover content in which students have not acquired the essential prerequisite skills presents yet another barrier to content coverage which can be removed through careful assessment of students' environments and achievement levels.

4. *Validity of the Tests used to Assess Content Mastery*

   Using inappropriate tests to measure students' content mastery is another significant barrier. Teachers, school administrators, and others must develop or select from published materials, instruments which match established curriculum goals and objectives and insure that students are provided instruction in each content area measured by the tests.

Grouping for Instruction

Principle 4: ***Students achieve more in classes in which they spend much of their time being directly taught or supervised by their teacher.***

Research

The manner in which teachers deliver instruction (i.e., in large/small groups or individually is an important instructional principle that directly impacts student achievement.

- In general, whole or large group instruction has been recognized as the most effective and efficient instructional approach to teaching basic skills (Brophy & Good, 1986; Englert, 1984; Kindsvatter, Wilen, & Ishler, 1988; Lorentz, 1980; cf., Rosenshine & Berliner, 1978; Stevens & Rosenshine, 1981). Grouping arrangement per se is not the primary determinant of student achievement. Rather, large group instruction appears to increase the time teachers provide instruction, demonstration, modeling, explanation, and corrective feedback (Brophy, 1979; Evertson, 1979). When students are in small groups or work individually, direct teacher instruction and monitoring become difficult for the teacher (Polloway; Cronin, & Patton, 1986; Evertson & Anderson, 1979; cf., Rosenshine & Berliner, 1978). McCaslin and Good (1992) reported that small group instruction may promote passivity and student dependency behaviors.

- In general, teacher instructional time that is spent with large groups is correlated positively with student achievement whereas teacher instructional time that is spent with only one or two students is correlated negatively with achievement. Though whole group instruction is positively and significantly related to student achievement, efforts to individualize instruction need not be abandoned. Polloway, Smith, and Payne (cited in Polloway, Cronin, & Patton, 1986) defined individualization as instruction that is appropriate to the individual. This type of instruction can be delivered individually, in small or large groups. As addressed by Polloway, Cronin, and Patton (1986), individualization is effective *if* it includes those elements of effective teaching.

- Johnson, Flanagan, Burge, Kaufman-Debriere, and Spellman (cited in Polloway, Cronin, & Patton, 1986) noted several advantages of whole or large group instruction: (a) more efficient use of teacher time; (b) more efficient student management; (c) increased instructional time; (d) increased peer interaction; and (e) increased generalization of skills. Additionally, large group instruction can promote observational and pragmatic learning, increase generalization of skills, and facilitate overlearning (cf., Polloway, Cronin, & Patton, 1986).

- As reviewed by Shavelson and Borko (1979), teachers reported using a variety of information to determine grouping arrangements in their classrooms. Student achievement levels, class participation, work habits, social competence, cooperation, self-concept and problematic classroom behaviors are all factors that teachers should consider when making grouping decisions.

Research (continued)

- Gamoran (1992) noted the following highlights of research on ability grouping and achievement: (1) "Ability grouping rarely benefits overall achievement, but it can contribute to inequality, of achievement, as students in high groups gain and low-group students fall farther behind. ", (2) "When student are grouped according to skills that are closely related to the curriculum, and when curriculum and instruction are tailored to students' capacities, ability grouping may raise achievement. Research at the elementary level supports this claim more so than at the secondary level, where there are few examples of effective instrucion in low-ability classes.", (3) The use of ability grouping should be curtailed, starting with its most rigid forms: permanent program assignments in high schools and between-class grouping for the whole school day in elementary schools." and (4) Where grouping is not eliminated, its implementation must be improved: neither teachers nor students should be locked into their assignments, and the quality of instruction in low groups must be raised." (p. 17)

- Gutierrez and Slavin (1992) in a synthesis of research on the achievement effects of the nongraded elementary school concluded, "that nongraded organization can have a positive impact on student achievement if cross-age grouping is used to allow teachers to provide more direct instruction to students but not if it is used as a framework for individualized instruction." (p. 333)

Limitations/Barriers to Effective Use

1. In classrooms characterized by extreme ranges in student ability, whole class instruction may be difficult. Although ability grouping may be necessary, McGeal (in Kindsvatter, Wilen, & Ishler, 1988) recommended that teachers should exert caution when working with small groups, making sure that they do not spend excessive amounts of time away from the remainder of the class.

2. As observed by Polloway, Cronin, and Patton (1986), there has been little attempt to determine the efficacy of one-on-one instruction. Additionally, the special education teacher may do well to carefully distinguish between individualization and one-on-one instruction. Consequently, grouping students for instruction may not run contrary to the intent of the individualized educational plan.

Scaffolded Instruction

Principle 5: ***Students can become independent, self-regulated learners through instruction that is deliberately and carefully scaffolded.***

Research

Definition of Scaffolded Instruction

- Hetherington and Parke (1986) offered the following definition of scaffolding: the process of helping children "... achieve more than they can on their own by skillfully structuring the environment to make it easier for them" (p. 293). In much the same way that a scaffold is used as a temporary structural support during building construction, scaffolded instruction serves as a temporary and adjustable support for students to develop new skills and abilities (Englert, Raphael, Anderson, Anthony, & Stevens,1991; Pearson, & Raphael, 1990).

- Implicit in the idea of scaffolded instruction is that the teacher enables learners to participate in complex tasks that they cannot perform adequately without assistance (Reid, 1991). Errors are *expected* and are corrected gradually through teacher re-direction and feedback. When implementing scaffolded instruction, teachers must ensure that sufficient, but not excessive, support is provided to the learner... a delicate balance between diminishing teacher guidance and increasing student competence should be maintained. Although the teacher initially assumes much of the control during scaffolded instruction, the ultimate goal of instruction is covert, independent self-regulatory learning.

- Inherent in scaffolded instruction is Vygotsky's (1978) notion of the zone of *proximal development*. Vygotsky defined this zone as "... the distance between the actual development level as determined by independent problem solving under adult guidance, or in collaboration with more capable peers" (p. 86). Stated simply by Harris and Pressley (1990), the zone of proximal development is that "area between what a learner can do independently (mastery level) and what can be accomplished with the assistance of a competent adult or peer (instructional level)" (p. 1).

Characteristics and Critical Features of Scaffolded Instruction

- Pressley, Harris, and Parks (in press) reviewed Rogoff's six characteristics of scaffolded instruction: (a) enlisting or recruiting of the learner's interests; (b) reducing the number of steps required to solve a problem to a level where the learner can meet the task requirements with assistance; (c) keeping the learner in pursuit of the task; (d) accentuation of the critical features of the task (e.g., comparing the learner 's product with the desired product); (e) keeping learner stress at a minimum; and (f) explicitly demonstrating task completion or explicitly modeling an idealized solution to a problem.

- The authors have identified five critical features of scaffolded instruction. They are as follows:

  1. <u>Scaffolding is Socially Mediated Dialogical Learning</u>

     According to Paris and Winograd (1990a), the distinguishing feature of scaffolded instruction is the prominent role of dialogue between teacher and student. This give-and-take exchange between teacher and learner, termed Socratic dialogue by Meichenbaum (1977), is reminiscent of Dewey's (in Sprinthall & Sprinthall, 1976) interactive concept of learning.

Research (continued)

The purpose of dialogical exchange is to provide the learner with enough guidance and support to accomplish goals that are impossible without assistance (Wood, Bruner, & Ross, 1976). As reviewed by Englert et al. (1991), Vygotsky 's notion of socially mediated learning referred to inner or egocentric speech that emerges during the social, dialogical exchange between the child and adult (or other more mature language user). The adult initially models much of the inner dialogue for the young child and controls the actions of the child through social mediation. However, over time and through repeated experiences, the child begins to internalize, and assumes responsibility for dialogical actions (i.e., it becomes a "private speech" spoken aloud by the child to direct personal cognitive activity). Eventually, this private speech becomes covert (i.e., inner, self-guided) which is automatic, requiring little conscious thought. The teacher's responsibility, therefore is to provide the conditions through which the child constructs his/her own understanding and use of the strategies that incorporates the essential elements of efficient and effective use.

2. Scaffolding Involves Elaboration of Learning

Students learn best when they are allowed opportunities to elaborate on material to be learned by making the connection between what is to be learned and what has been learned previously (Pressley, McDaniel, Turnure, Wood, & Ahmad, 1987; Swanson, 1991). According to King (1992), elaboration has many forms: addition of details to information, clarifying ideas, explaining and contrasting two or more concepts, making inferences, visualizing an image of material to be learned, making analogies to relate new ideas to familiar ideas, or associating new material with past knowledge or experiences. implicit in the idea of elaborative learning is that such an activity makes material more meaningful and personal to the learner. As reviewed by King (1992), learners frequently do not engage in elaboration without prompting or cueing nor do they spontaneously activate and use their prior knowledge. Additionally, King noted that self-generated elaborations have been found to be more effective than those provided by teachers, textbooks or other external sources.

In their informative review, Englert et al. (1991) stated: "Teachers have the responsibility to model strategies as they 'think aloud' to make visible the normally invisible cognitive processes..." (p. 339). As noted by these authors, it is equally important that students participate in this collaborative social dialogue as they begin to take increasing responsibility for their inner speech and active learning (*An important caution*: scaffolded instruction is *not* simply modeling or thinking aloud about cognition, it's completion occurs only when learners have covertly internalized the dialogue on an automatic, unconscious level).

As addressed by Englert et al. (1991), teachers scaffold in many ways. Some of these ways include (a) activating background knowledge by asking a series of graduated questions that help students retrieve relevant information, (b) acting as a coach who provides tips, strategies, and cues to engage students in processes that promote independent learning, and (c) procedural facilitation (e.g., providing prompts such as "think sheets" that prompt students to engage in specific strategies, such as the steps involved in long division).

Research (continued)

3. Scaffolding is Proleptic Teaching

Proleptic teaching, as described by Palinscar (1991) and Pressley, Harris, and Marks (in press), refers to instruction that anticipates learner competence. That is, scaffolded instruction assumes that eventually, each student will attain independent, self-regulated competence of the skill.

4. Scaffolding is an Individualized Instructional Approach

Scaffolded instruction is an individually tailored form of instruction in which the teacher should consider the learner's needs, predilections, interests, and abilities (Harris & Pressley, 1990). A functional assessment to determine the processes each child employs to solve computations is critical to effective scaffolded instruction. Teachers should be sensitive to the rather unique, sometimes ineffective, problem-solving approaches children use. The results of such assessment lead to individualized planning and implementation of individually tailored scaffolded instruction.

5. Scaffolding Involves Both *Recursive* and *Spiral* Learning

Thinking, according to Schiever (1991), develops from concrete to abstract concept processing. While the notion of scaffolded instruction remains recursive (i.e., the instructional processes remain the same, though dynamically tailored to the child's individual needs), increasingly complex learning concepts, presented in a spiral fashion, can be provided.

Instructional Models that Incorporate Scaffolded Instruction

- Among the numerous models include critical features of scaffolded instruction in their designs. are: reciprocal teaching (Palinscar & Brown, 1984; cognitive apprenticeship (Collins, Brown, & Newman, 1989); self-generated verbal elaboration (King, 1992); and self-instructional strategy development (Graham and Harris, 1989).

Limitations/Barriers to Effective Use

Limitations of Scaffolded Instruction

1. *Initially, Scaffolded Instruction is Labor Intensive*

   As the zone of proximal development may differ for each student, the teacher may become overwhelmed when attempting to use scaffolded techniques.

2. *Scaffolded Instruction Requires an Empathetic Teacher*

   Teachers who implement scaffolded instruction must be sensitive to student needs. Awareness of the student needs and abilities is central to successful implementation.

3. *Scaffolded Instruction Requires a Skilled Teacher*

   A teacher who implements scaffolded instruction must be skilled in dialogical, mediated learning techniques. Teacher preparation in this area is critical to successful implementation.

4. *Some Teachers may have Difficulty with the Degree of Error that Occurs in the Initial Phases of Scaffolded Instruction*

   Teachers may have difficulty accepting the graduated nature of scaffolded instruction. Special education teachers may be accustomed to providing students with material at a level that ensures almost errorless learning. During scaffolding, as students progress from a mastery level of some information to gradually becoming more independent while learning the new material, errors may occur. Although the goal for students when learning the new information is to achieve mastery, teachers may not be comfortable with allowing students to make any errors. Teachers may have to revamp grading procedures to not penalize students under these circumstances.

5. *Scaffolded Instruction Does Not Readily Lend Itself to Teacher-Manuals, Curriculum Guides, etc.*

   Many available teacher-manuals and curriculum guides have linear orientations that do not address this recursive process of learning and scaffolded instruction(Paris and Winograd,1990b; Reid ,1991; and Herman,1990).

Addressing Forms Of Knowledge

Principle 6: ***The critical forms of knowledge associated with strategic learning are (a) declarative knowledge, (b) procedural knowledge, and (c) conditional knowledge. Each of these must be addressed if students are to become independent, self-regulated learners.***

Research

- Any discussion of knowledge might best be prefaced by an overview of the importance of metacognition and its central role in learning. Metacognition (i.e., *knowing about knowing*), a term originated by Flavell (cited in Wong, 1991), is defined as "... one's knowledge concerning one's own cognitive processes and products or anything related to them, e.g., the learning-relevant properties of information or data" (cited in Wong, 1991, p. 233. Flavell (cited in Wong, 1991) identified two types of metacognitive activities: (a) knowledge about cognition and (b) regulation of cognition. Knowledge about cognition, according to Wong (1991), "... concerns an individual's knowledge about his own cognitive resources and the compatibility between himself as a learner and the learning situation." (p. 233) Knowledge about regulation of cognition include one's awareness and control over cognition during problem-solving (e.g., planning, monitoring, testing, revising, and evaluating).

- Alexander, Schallert, and Harre (1991) defined knowledge as encompassing "... all that a person knows or believes to be true, whether or not it is verified as true in some sort of objective or external way" (p. 317). Numerous researchers and theorists have proposed different forms of knowledge (cf., Billingsley & Wildman, 1990; Bos & Vaughan, 1988; cf., Bransford, Sherwood, Vye, & Rieser, 1986; Derry, 1990; Hresko & Parmar, 1991; Sternberg, 1991). However, according to Alexander, Schallert, and Hare (1991), regardless of the type of knowledge studied, (e.g., content knowledge, linguistic knowledge), three distinct forms of knowledge are subsumed: (a) *declarative*, (b) *procedural*, and (c) *conditional*. For example, if we refer to a domain-specific knowledge, such as mathematics, we (a) know factual information about it (declarative knowledge), (b) know how to use the knowledge in specific ways (procedural knowledge), and (c) know when and where to apply this knowledge (conditional knowledge).

Limitations/Barriers to Effective Use

1. *Terminology Problems*

Alexander, Schallert, and Hare (1991) effectively argued that researchers and practitioners alike have used a multiplicity of terms to define the construct of knowledge. This proliferation of terms, they asserted, has led to numerous loosely defined concepts of knowledge, with no conscious attempt to provide more precise definitions. Ramifications of using these ill-defined concepts include (a) an inadequate referential base upon which researchers and practitioners may communicate, and (b) a deleterious impact on research findings may represent the idiosyncratic meanings researchers attach to their findings.

Organizing and Activating Knowledge

Principle 7: ***Learning is increased when teaching is presented in a manner that assists students in organizing, storing, and retrieving knowledge.***

Research

- The prior knowledge a learner brings to a task plays a central role in the acquisition of new learning (Beck, 1986). If a learner is unable to access prior knowledge he/she has lost access to foundational blocks that support new learning.

- According to Prawat(1989), the major goal of education is to promote the transfer of knowledge and skills. As defined by Prawat (1988), transfer is the ability to access one's own knowledge in situations in which that knowledge may be relevant.

- Inability to access prior knowledge may occur for three reasons. First, students may *lack* a sufficient knowledge base upon which to access information. Second, students may have *poorly organized* knowledge, and consequently, retrieval of this knowledge may be inhibited. Finally, unless one is aware that one *possesses* relevant knowledge and is cognizant of the *conditions* under which that knowledge is *relevant*, one will fail to access this knowledge.

- As reviewed by Jones, Palinscar, and Ogle (1987), there is considerable evidence that empowered learners have not only acquired a substantial knowledge base, but their acquired knowledge is better organized and integrated than that of novice or ineffective learners. Additionally empowered learners, are able to *flexibly* access their knowledge to assist them in relevant problem-solving situations.

How do learners acquire and organize knowledge?

- Various models of information processing theory have been proposed (Anderson, 1983; Quillian,1969). Each model has attempted to describe the manner in which new sensory input is perceived, transformed, reduced, elaborated, stored, retrieved, and used (Bos & Vaughan, 1988). Due to factors such as interference and decay, learners may loose information if intensive efforts are not made to store the information into long-term memory. Once transferred to long-term memory, information *may* or *may not* be retrievable or accessible in relevant situations. Retrieval is highly dependent upon the strategies used by the learner to process information (Bos & Vaughan, 1988).

Research (continued)

Types of Memory

- According to Brewer and Pani (cited in Bos & Vaughan, 1988), information is organized into three dynamically interactive types of memory (a) personal, (b) skill, and (c) semantic memory. Personal memory is the remembrance of a past episode including such representations as time and location. Information stored in skill memory represents memory for carrying out motor and/or cognitive operations (e.g., procedures used to add digits with regrouping required, or how to drive a car). Semantic memory represents information stored in terms of concepts or meaningful ideas.

Network Models of Memory

- In semantic network models of memory, such as that proposed by Quillian (cited in Glover, Ronning, & Bruning, 1990), semantic knowledge is represented as a web or "network." Quillian (1969) noted that memory could be represented as a hierarchical semantic network where nodes are concepts arranged in superordinate-subordinate relationships. The number of nodes and linkages are important, but the strength of those linkages is critical in activating knowledge in potentially relevant situations.

- Prawat (1989) stressed that cognitive organizational structure is provided by the connections or links between elements of the knowledge base. Accessibility of prior knowledge is a function of the *strength* of these relational or associative links. Prawat argued that the promotion of relational understanding during instruction is imperative if educators are to increase and strengthen the linkages or connectedness in ideas and facilitate student organization and access of knowledge.

Assisting Learners to Activate Prior Knowledge

- Learners can engage in numerous activities that can assist them in organizing and storing knowledge. Swanson (1991) identified eight sequential stages of information processing that are essential to organizing, storing, and retrieving knowledge. The degree to which the learner engages in these activities determines the accessibility and utility of the information in future problem-solving situations.

- According to Glover, Ronning, & Bruning (1990), schema activation is "... an array of activities designed to activate relevant knowledge in students' memory prior to encountering new, to-be-learned information" (p. 251). Students activate prior knowledge through using instructional and content organizers, semantic mapping, semantic features analysis, and anchored instruction.

The Problem of Access Failure

- Bransford, Sherwood, Vye, and Rieser (in Prawat, 1989) reviewed numerous studies suggesting it is *access failure*, not knowledge acquisition per se', that is often at the root of poor student performance. That is, while learners often have acquired information that will assist them in solving tasks, they do not always access this information in relevant situations.

The Role of Specific Knowledge

- As noted by Glover, Ronning, and Bruning (1990), as students learn more about a *specific* topic, it is easier for them to learn and remember information. Lack of specific knowledge may inhibit both comprehension and memory abilities. The availability of specific knowledge enhances the learner's ability to make inferences which serve to fill gaps in incoming information.

Research (continued)

Teaching Conditional Knowledge

- Bransford, Vye, Kinzer, and Risko (1990) stressed the importance of specific content knowledge for thinking and problem solving. Educators must not teach content in a rote, highly context-specific manner which increases the likelihood that knowledge will remain inert but must teach **conditional knowledge** as well. Bransford and Vye cited numerous studies demonstrating that when information is merely memorized, it will remain inert and fail to transfer to potentially relevant situations.

Meaningfulness

- Bransford et al. (1990) stressed the importance of "meaningfulness" in knowledge organization and acquisition. Both organization and recall of knowledge abilities are enhanced when content is presented within meaningful contexts.

Cognitive Rigidity and Flexibility

- Westman (1990) noted that as a result of cognitive rigidity, behavior is not efficiently adapted to situational changes. In contrast, cognitively flexible children are versatile learners who vary their strategies according to task demands. Children with rigid cognitive styles may be able to activate their knowledge only in contexts which closely resemble the original learning situation.

- Bereiter and Scardmalia (1985) stressed that instruction designed to teach both knowledge acquisition and utilization will inevitably fail if direct efforts are not made to teach students how to use acquired knowledge flexibly in solving real-life problems. These researchers argued that most school tasks do not pose the kinds of knowledge access demands that tasks in everyday life necessitate.

- Cognitive rigidity is promoted when learning is embedded within the context of very specific cues that inhibit the flexible memory searches that real-life problem solving requires. Bransford and Vye (1989) refer to this adaptive behavior as a type of "knowledge-telling strategy" that is characteristic of strategies many children employ in school. These coping strategies serve to keep knowledge inert.

Addressing Informal and Intuitive Knowledge During Instruction

- A learner's informal or intuitive knowledge may impact knowledge organization acquisition. As concluded by Bransford and Vye (1989), if students persist in using the wrong strategies, no new learning is possible and informal knowledge may be replete with misconceptions uncorrected.

Techniques and Methods to Facilitate Knowledge Acquisition, Activation, and Utilization

- Bransford et al. (1990) cited ways teachers can facilitate prior knowledge acquisition and utilization.

  1. Incorporating Conditional Knowledge into the Content Instruction

  2. Assisting Students in Distinguishing Between Knowledge Acquisition, Activation, and Utilization

  3. Providing Students with Opportunities to Solve a Variety of Problems from Different Perspectives

  4. Curricula materials should be designed from multiple perspectives

- Bos and Vaughan (1988) emphasized selecting major concepts and related vocabulary prior to instruction. Both schema and scaffolding theories suggest that teachers should design instruction facilitating the scaffolding process while simultaneously ensuring that the relationships among concepts is carefully delineated. To-be-learned material should be presented to activate prior knowledge and assists the learner to organize and process knowledge effectively. Major concepts are best understood when succinctly articulated to students.

Research (continued)

Instructional Techniques that Promote Knowledge Acquisition, Organization, and Retrieval

Semantic Features Analysis

- According to Bos and Vaughan (1988) semantic features analysis (SFA) "...is a prelearning activity that serves to organize the major concepts and related vocabulary to be taught..." (p. 193). To prepare a SFA activity, the teacher must first develop a relationship chart that depicts the relationships of central ideas or concepts. Superordinate concepts (i.e., the most inclusive or abstract concepts or ideas) and subordinate concepts (i.e., more specific, narrow concepts or ideas) are determined. Additionally coordinate concepts (those that fall somewhere between superordinate and subordinate concepts) are selected and placed on the relationship chart. Once depicted, the relationships between the concepts are discussed and related to the students' background knowledge. After reviewing the relationship chart, students then read or complete the assigned activity to confirm or disconfirm their the relationships between concepts (Bos & Vaughan, 1988).

Content Organizers

- Various forms of graphics provide visual displays of a subject matter's organization of structure (e.g., charts, diagrams, etc.). Figural taxonomies are graphics that display superordinate, subordinate, and coordinate relationships among concepts, facts, and details, or some combination (Scruggs, Mastropieri, Levin, McLoone, Gaffney, & Prater, 1985). Several research studies have demonstrated the efficacy of graphic organizers in promoting students learning (Bergerud, Lovvitt, & Horton, 1987; Koran & Koran, 1980; Moyer, Sowder, Threadgill-Sowder, & Moyer, 1984).

- Content diagrams can also be effectively used as organizational devices when teaching students complex abstract concepts (Bulgreen, Schumaker, & Deshler, 1988). Critical features are depicted in conceptual categories, characteristics, examples and non-examples.

Study Guides

- Teachers can cue the organization of information by using structured study guides. Such guides are comprised of a set of statements or questions designed to accompany reading assignments and class lectures (Ellis & Friend, 1991). Two approaches commonly used are (a) giving the student the study guide to use as s/he independently completes an assignment and (b) requiring the student to first read the passage and then complete the study guide.

- Three common types of study guides are (a) multi-level guides, (b) concept guides, and (c) pattern guides (Horton & Lovitt, 1987).

Instructional Organizers

- Ellis & Friend(1991) defined instructional organizers as "... teaching routines used to help students understand what is being learned and to integrate new information with that which is previously learned"(p. 96). Additional advantages of instructional organizers cited by Ellis include (a) helping students to distinguish between important and unimportant information, and (b) assisting students to store the new information in an organized manner which enhances future retrieval.

- Ellis (1991; 1992) identified three types of instructional organizers that have received empirical support for helping students to recognize the organizational patterns of instruction and which assist them in knowledge acquisition, organization, and retrieval: (a) advance organizers, (b) lesson organizers, and (c) post organizers.

Research (continued)

(a) Advance Organizers

An advance organizer as defined by Ausubel and Robinson (1969) is "... material that is presented in advance of and at a higher level of generality, inclusiveness, and abstraction that the learning task itself" (p. 606). Advance organizers (Ausubel & Robinson, 1969) are based upon schema theory and provide students with a needed framework to organize information. Mayer (1979) noted that advance organizers are particularly beneficial to students with low ability or students who possess limited background knowledge of the material.

(b) Lesson Organizers

During the lesson, teachers can use a variety of organizers to assist students in understanding the structure of the lesson. Several lesson organizers described by Ellis (1991; 1992) include:

Using organizing words (such as "*First*," "*Second*," "*Third*," etc.).

Using explicit words to cue students that the information being presented is critical.

Using explicit cues to help students to draw important relationships, associations, and to integrate previously learned and new information

Making expectations explicit to students.

(c) Post Organizers

Post organizers are designed to provide closure to a lesson. Teaching can assist students in gaining closure to the lesson by:

Cueing them that a post organizer is presented

Evaluating students to see if they have assimilated the new information.

Forecasting learning to-be-acquired in future lessons (Ellis & Friend, 1991).

Anchored Instruction

- Anchored instruction (Bransford et al., 1990) "anchors" or immerses instruction in rich learning macro-contexts that permit active student problem solving, exploration, and discovery. The major goal is to let students experience the changes in their perception and understanding of the anchor as they view the situation from multiple points of view (Bransford et al., 1990; p. 391). Once immersed and reflection and understanding of the perceptual changes have been realized, learners can use the learning acquired in bridging the anchored contexts to other relevant contexts.

Semantic Mapping

- Semantic mapping is an instructional technique used to categorically structure information in graphic form (Johnson, Pittelman, & Heimlick, 1986). Semantic maps are prelearning activities that assist students in activating prior knowledge and in seeing the conceptual relationships between prior knowledge and the to-be-learned information (Bos & Vaughan, 1988). Comprehension, according to Pearson and Johnson (1984) bridges new and old information. Semantic mapping is a technique which promotes this conceptual/organizational bridging. Rewey, Dansereay, Dees, Skaggs, and Pitre (1991)provided empirical evidence of the efficacy of mapping techniques. While a map may enhance main or central ideas, it sometimes eliminates essential details.

Limitations/Barriers to Effective Use

1. *Teaching Inflexibility in Planning*

Once the teaching plan has been made, many teachers appear to be inflexible; their plans tend to be made early in the year, and subsequent changes are rarely made (Anderson & Evertson, 1978; Brown, 1988). Teacher inflexibility may be due to inability to efficiently process a wide array and quantity of information produced during ongoing classroom instruction (Clark & Peterson, 1986). Brophy (1984) noted that teachers are reluctant to change their routines even when they are not working well because established routines tend to reduce the complexity of teacher planning. Teachers may have limited knowledge of effective and efficient alternative routines.

Lenz et al (1988) drew several conclusions from the teacher-thinking and planning research. First, teaching is a complex task that requires a good deal of planning and decision making, yet few teachers are expert enough to function as effective decision-makers in light of the wide range of content and method selection, adaptation, supplementation, evaluation, remediation and adjustment of plans needed when considering the various learning needs of academically disabled students. Second, teachers are not always responsive to unexpected problems and needs of students during class routines, therefore instructional procedures that address the needs of academically disabled students are those routines and devices that promote effective and efficient information-processing in students that can be readily incorporated into teachers' planning and teaching processes. Third, instructional practices should include procedures that promote student ownership and control of the instructional process since one goal of instruction is to make students independent learners. This can be addressed by viewing teaching more as a collaborative process between teachers and students. Fourth, teachers must be instructed in pedagogy based upon information-processing and decision-making and in the appropriate use of the pedagogy.

2. *Lack of Teacher Preparation*

Information processing theories and related teaching methods and techniques are areas of teaching that require extensive teacher education preparation. Techniques, such as anchored instruction, require relatively extensive teacher education to implement effectively. More teacher education at both pre-service and in-service levels is needed for teachers to develop the competencies required to implement many instructional techniques/approaches based upon information processing research.

3. *Lack of Teacher Time*

Development of materials such as content organizers, study guides, instructional organizers, etc. may tax the time of the already overburdened teacher. Curriculum publishers and developers can help to alleviate this problem by including these techniques and methods in the materials.

Teaching Strategically

Principle 8: ***Students can become more independent, self-regulated learners through strategic instruction.***

Research

- Strategic instruction, a cognitive-behavioral modification approach derived from operant, social, and cognitive learning theories, assumes that students' thinking processes, like observable behavior, can be altered through mediation. A strategic approach to teaching is *not* designed to teach content, but designed to enable students to use their existing knowledge in an optimal fashion when learning content. Strategic instruction is designed to teach students "how to learn" effectively (Deshler, Schumaker, & Lenz, 1990; Schumaker, Deshler, Alley, Warner, & Denton, 1982). Effective strategic instruction involves teaching strategies enabling students to successfully and independently accomplish academic tasks. Within the last ten years, there has been substantial research support for strategic instruction in improving student performance and achievement (cf. Harris & Pressley, 1991).

Expert-Novice Research

- Numerous research studies have identified the characteristics of expert and novice (i.e., new or ineffective) learners and suggested that these two groups of students approach learning in strategically different ways (cf. Prawat, 1989; cf. Harris & Pressley, 1991). "Expert learners are aware of, and control their efforts to use particular skills and strategies" (Jones, Palinscar, Ogle, & Carr, 1987, p. 14). This awareness includes effective use of both procedural and conditional knowledge. These students are not only knowledgeable about *how* to use specific cognitive strategies, but also, are knowledgeable about *when* strategies should be used. Other characteristics of expert learners identified by Jones et al. (1987) are that they: (a) access particular strategies with flexibility, and (b) develop a repertoire of effective cognitive and metacognitive learning strategies spontaneously without special interventions as they progress through school .

- In contrast, novice learners do not appear to have a repertoire of the basic cognitive and metacognitive strategies needed to assist them in learning (Jones, 1986). Research results of studies conducted by Winne and Marx (1982), have suggested that irrespective of ability, students able to articulate specific cognitive strategies perform better than students who are able to only express general, somewhat vague, strategies. Furthermore, the student strategy processes appear to be very good predictors of student achievement (Winne & Marx, 1982).

- Schuler and Perez (1987) and Jones (1986) maintained that many low-achieving students and those with disabilities (e.g., learning disabilities and behavioral/emotional disorders) are being viewed increasingly as having cognitive disabilities which revolve around poor planning, organization, self-checking, and problem-solving in metacognition, primarily because they are seen as passive learners with ineffective problem-solving strategy repertoires. Several researchers (e.g., Sheinker, Sheinker, & Stevens, 1984) have suggested that strategy instruction holds much promise for assisting learning disabled and other low-achieving students to reach their full potential.

Research (continued)

Definition of a Strategy

- According to Deshler and Lenz (cited in Lenz, 1992), a strategy is "... an individual's approach to a task; it includes how a person thinks and acts when planning, executing, and evaluating performance on a task and its outcomes" (p. 143). Such strategies, as addressed by Schunk and Rice (1992), enable students to engage in the following self-regulatory activities: (a) attending to tasks; (b) focusing on relevant features of the task; (c) rehearsing information; (d) elaborating; (e) monitoring levels of understanding; (f) taking corrective action, if needed, (g) cueing them to retrieve information, and (h) helping to maintain a favorable emotional climate that is conducive to learning.

- Ellis (1992) and Wong (1991) distinguished between cognitive and metacognitive strategies in the following manner. Cognitive strategies are the "tools" one used for solving specific types of problems across a variety of situations (e.g., an outlining strategy). Metacognitive strategies are the processes one uses to figure out which cognitive "tool" is needed, which one to select, to evaluate how it works, and to determine if another strategy is needed (e.g., determining if note-taking is effective).

Strategic Instructional Approaches

- One goal of strategy instruction is to teach learners to apply techniques, principles, or rules which enable them to solve problems and to complete tasks *successfully* and *independently* (Ellis, 1992). While terminology for these two broad-based approaches have varied (e.g.,direct and indirect instruction), we shall refer to these approaches as *constructive* and *instructive*. As noted by Ellis (1992), the primary difference between the two approaches is the *role of the teacher*. In the constructive (indirect) approach, the teacher guides the student to the knowledge and use of the strategy and prompts students to use strategies through modeling, questioning, shaping, and correcting. The teacher using indirect strategy instruction guides the student through the task, and as instruction progresses, gradually releases the student to take responsibility for the effective and efficient completion of the task. In some instances, the teacher never presents the "best" strategy, but allows the student to discover the best approach to the task (Ellis, 1992).

- When using direct, instructive strategy approaches, the teacher explicitly teaches a specific strategy (although the student is encouraged to adapt and personalize the strategy) (Ellis,1992). The instructive strategy approach focuses on teacher identification of an effective and efficient strategy for rather specific tasks (e.g., notetaking) and training the student to use the strategy. Once an appropriate strategy has been determined, the teacher assists the student by: (a) ensuring that the student has mastered the essential prerequisite skills necessary for strategy use; (b) presenting the strategy; (c) modeling and demonstrating the strategy, and (d) providing the student with practice and feedback about the student's application of the strategy (Ellis, 1992). The major difference between the two strategic approaches is not the constructivism, but rather, the explicitness inherent in the instructional processes. Whereas in constructive approaches, the teacher and student "think aloud" tacit processes, direct instructive approaches place emphasis on the direct teaching of specific strategies to solve learning problems. *Both* approaches allow students the opportunity to personalize and construct their own meanings.

- The direct instruction of strategies can be either general or specific in nature. As reviewed by Prawat (1989) some direct instructional strategies may be too specific, thereby decreasing the likelihood that students will generalize or transfer them to other potentially relevant contexts. As Scardamalia and Bereiter (in Prawat, 1989) maintained, very general strategies may play a more important role when conceptual knowledge is meager.

- Specific strategies are more teachable but can only be applied in a limited number of contexts whereas general strategies are more versatile but are also viewed as more difficult to teach (Prawat, 1989). Specific strategies are by definition very prescriptive (Prawat, 1989).

Research (continued)

Characteristics of Effective Strategy Instruction

- **The following research-based statements characterize the critical characteristics of effective strategy instruction, whether they are direct or indirect in nature.**

  Effective strategy instruction includes the critical features of scaffolding (i.e., planning, monitoring, and evaluation (Pressley, Harris, & Marks, in press; Pearson & Raphael, 1990).

  Good strategy instruction promotes the active participation of students in their own learning (Winne & Marx, 1982; Peterson & Swing, 1982).

  Good strategy instruction has as its long-term goal the ownership of strategies by students, i.e., students personalize and adapt strategies, know when, where, and how to use them, and are motivated to use them (Harris & Pressley, 1990).

  Good strategy instruction is characterized by strategies that are both *effective* (i.e., they enable the student to meet the demands of current and future tasks) and *efficient* (i.e., they enable the student to meet task demands in a timely, resourceful, and judicious manner) (Ellis & Lenz, 1987).

  The content of various strategies is organized strategically for maximal learning (Ellis, 1992).

- In an analysis of effective strategies, Ellis and Lenz (1987) identified the following critical features.

  A Strategy Must be Useful

  A strategy should assist the student in solving a key problem found in current settings faced by the student.

  A strategy should enable the student to face similar demands across settings.

  A strategy should be applied frequently to meet setting demands.

  A strategy should be designed to be conducive to generalization across settings.

  The Process of a Strategy Should Be Strategic

  The strategy should contain steps that lead to a specific outcome.

  The steps of a strategy should be sequenced in such a manner that t leads to successful task completion.

Research (continued)

The steps of the strategy should cue the student to use cognitive strategies, metacognitive processes, and appropriate skills and rules.

The steps of a strategy should cue the student to take some type of observable action.

The steps of a strategy should be completed in a short period of time.

Effective Features of Strategy Models

- Whether direct or indirect in design, most contemporary strategy teaching models incorporate a variety of features that promote student acquisition, utilization, and generalization of strategies. (Pressley, Harris, and Marks, (in press).

  Introduction of only a few strategies at a time.

  Teaching and practice extended over a lengthy period of time and across diverse tasks.

  Strategic teaching occurs within the context of realistic academic tasks.

  Teachers extensively model strategies and provide verbal explanations and collaborative discussion of the thinking processes associated with strategy steps.

  Teachers explain and discuss with students the value of strategies and rationales for using them.

  Teachers provide extensive feedback and engage in substantial collaborative discussion with students as they learn and attempt strategies, and teachers provide re-explanations and re-teaching when necessary.

  Teachers and students determine opportunities for transfer (i.e., identify specific situations within the student's academic environment for strategy use).

  Throughout instruction, teachers attempt to keep motivation high, largely by highlighting the empowerment that accompanies acquisition of powerful procedures that accomplish important academic tasks.

  Teachers encourage habitual reflecting and planning. Teachers model reflection and provide opportunities for students to think through the solutions to their academic problems.

Limitations/Barriers to Effective Use

1. *Difficulty Explicating Tacit Processes*

   Polyani (cited in Wong, 1992) pointed out that much of knowledge is *tacit* (i.e., it cannot be explicated in words under normal conditions. Tacit knowledge represents that knowledge which has become automatic (e.g., tying a shoe, etc.).

2. *Adequate Prerequisite Skills/Knowledge of the Learner*

   Sheinker, Sheinker, and Stevens (1984) cited several studies which suggested that strategy generalization may be difficult for those children whose achievement is below the mid-third to fourth grade level. Additionally, Deshler, Schumaker, Lenz, and Ellis (1984) suggested that strategy instruction may not be appropriate for students with severe disabilities. Both Wong (1985) and Miyake and Norman (1978) noted the prior knowledge and skills students bring to a task is a critical consideration prior to the implementation of strategy instruction. Sheinker, Sheinker, and Stevens (1984) warned educators of the danger of perceiving strategy instruction as a substitute for content instruction. They recommended that strategy instruction be a distinct, well-organized part of the on-going curriculum, embedded in real-life learning contexts.

3. *Teacher Assumes the Initial Responsibility for Strategy Instruction*

   Whether strategy instruction is direct or indirect, teachers must assume the initial responsibility for instruction. Several researchers (e.g., Deshler et al., 1984; Ellis, Deshler, & Schumaker, 1989) have noted that while this is essential during the initial stages of instruction, it is not conducive to learner independence in the long-term. As addressed by Harris and Pressley (1990), it becomes critical that students begin to generate and personalize their own strategies, independent of teacher assistance. Ellis, Deshler, and Schumaker (1989) demonstrated that students can be taught to generate or adapt executive strategies to successfully solve novel problems.

4. *Limited Applicability to Lower-Order Thinking Tasks*

   Deshler et al. (1984) and Schuler and Perez (1987) noted that a cognitive strategy approach may be more appropriate for higher-order tasks rather than lower-order tasks. Sheinker, Sheinker, and Stevens (1984) suggested that more traditional techniques, like direct instruction and mastery learning, may be more effective in teaching literal skills whereas strategy training may be more effective in the teaching of inferential skills.

5. *Limitations in Our Understanding of the Developmental Nature of Generalization and Maintenance*

   Harris and Pressley (1990) noted that we know very little about the breadth, depth, and course of the developmental and generalization capabilities of children, and have little but intuition to guide us in setting reasonable criteria and evaluation outcomes in our research. It has become increasingly apparent that less explicit instruction is needed to promote durable strategy application with older children than is the case with younger, normally achieving students. Metacognition as relevant to strategy use appears to develop with age and experience.

6. *Strategy Instruction Requires Teacher Education*

   Several authors have addressed the extensive training that is required to successfully implement strategy instruction (Ellis, 1990; Hermann, 1990; Pressley, Harris, & Marks, in press). Consequently, education at both the pre-service and inservice levels may be needed to ensure that effective implementation of strategy instruction occurs.

Making Instruction Explicit

Principle 9: ***Students can become independent, self-regulated learners through instruction that is explicit.***

Research

The extent to which instruction is made explicit directly impacts both student achievement and independent, self-regulated learning.

- Generally, much research (cf. Rosenshine & Berliner, 1978) within the past twenty years has been focused on the efficacy of both didactic (i.e., formal, controlled instruction) and heuristic (formal, inquiry, discovery-oriented teaching) instructional models. In didactic models, teachers make explicit instructional goals, objectives, content, and expectations to students. Explicitness in instruction runs counter to heuristic models as students, through exploration, develop their own interests, goals, and objectives. Didactic models such as direct instruction, mastery learning, and precision teaching have been found to be superior to heuristic models, such as discovery learning, in promoting student achievement (cf. Berliner, 1978; cf. Kindsvatter, Wilen, & Ishler, 1988).

- Research on explicit teaching has been undertaken within both the process-product and cognitive-learning paradigms. The results highlight what appear to be complimentary research findings.

Explicit Teaching and Cognitive Learning Research

- As Rosenshsine (1986) noted in his extensive review, three areas of cognitive processing research directly support the need for explicit teaching. These three areas include (a) research which supports the limitations of working memory; (b) research which highlights the importance of practice, and (c) the importance of continuous practice until students are fluent. Current research suggests that there are limits to the amount of information to which students can attend and process effectively. Consequently, when too much information is presented at any given time or when processing demands become too great, students' working memory may become overloaded. One implication from this research is when teachers present new or difficult material, they should do so in small steps, arranging for practice after each step. Teachers can also assist students processing information by providing outlines that highlight major points or concepts or that present main ideas of the material.

- As reviewed by Rosenshine (1986), students have to process new material effectively in order to transfer it from working memory to long-term memory. That is, they have to elaborate, review, rehearse, summarize, or enhance the material in some way to increase the likelihood that information will be transferred to long-term memory. Students can do this through *active practice* which is facilitated if the teacher asks students questions, requires them to summarize main points or themes, has students tutor one another, and supervises students as they practice new steps in a skill. Extensive practice and frequent review are needed after the material is first learned so that it can be recalled effortlessly and automatically in future work. When prior learning is automatic and fluent, this frees space in our working memory which can be used for application and higher-level thinking.

Research (continued)

Process-Product Research

- **Cooper (1982) defined an effective teacher as "... one who is able to bring about intended outcomes" (p. 59). Several research-based statements support the contention that the explicit manner in which effective teachers conduct their lessons results in the realization of their intended outcomes. These statements follow.**

1. Making Goals, Objectives, and Expectations Explicit

First, and perhaps most importantly, effective teachers make explicit to students their goals, objectives, and expectations. Effective teachers, according to Leinhardt (1986), implement their lessons in academic environments which focus on the *specifics* that students are expected to learn. Such explicitness appears to provide learners with a structured environment in which they can predict and comprehend adequately (Anderson, Stevens, Prawat, & Nickerson, 1988).

2. Making Instructional Content Explicit

Leinhardt (1986) in reviewing research on effective teaching, concluded that expert teachers are especially good at constructing lessons that successfully communicate the content that needs to be learned.

According to Rosenshine (1986), the research conducted since 1974 has yielded a consistent pattern of instruction that supports instruction of well-defined skills. By carefully defining skills to be mastered, effective teachers are able to present information in small steps pausing long enough to ensure that students have mastered each step (e.g., through guided practice, eliciting active and successful participation from all students. In general, Rosenshine (1986) reported that when effective teachers teach concepts and skills explicitly, they routinely engage in the following activities.

- They begin each lesson with a *concise statement of goals.*
- They begin each lesson with a short *review* of previous and/or prerequisite skills.
- They present new information in *small steps* with student *practice* following each step.
- They give *clear and detailed instructions* and explanations.
- They provide *active practice* for all students.
- They ask many questions, *checking for student understanding* and obtain responses from all students.
- They *guide* students throughout initial practice.
- The provide *systematic feedback and corrections* in a timely manner.
- They provide explicit instruction and practice for seatwork exercises and when necessary, monitor students throughout seatwork activities.
- They continue to provide practice until students are *fluent and confident.*

Rosenshine (1986) identified six teaching functions that serve to make the instructional process more explicit for students. These teaching functions were also supported in Clark's 1992 review.

(a) First, teachers can make instruction more explicit by engaging in daily ***reviews*** which may include reviewing homework, relevant previous learning, or prerequisite skills. The focus of such reviews serves to activate students' prior knowledge of relevant concepts that facilitate linkage between students' prior knowledge and the new material.

(b) When **presenting new material,** teachers should make explicit their goals and objectives for students.

Research (continued)

(c) After the presentation (or after short segments of the presentation) the teacher should engage students in ***guided practice.*** Rosenshine recommended success rates somewhere between 75-80% during initial practice sessions.

(d) During and after students practice skills, teachers should provide explicit ***feedback and correctives*** to students. Teachers should make sure that they tell students when their answers are correct. Additionally, teachers frequently should provide process or procedural feedback to students. Errors should not go uncorrected. Finally, instruction is more effective when teachers teach to mastery before moving on to new material.

(e) Following initial and guided opportunities for independent practice, teachers should provide opportunities for students to engage in ***independent practice***. This type of practice enables students to become fluent and promotes automaticity (i.e., the level at which they are able to complete skills successfully and rapidly without having to think through each step).

(f) To assist students to remember the information learned, teachers should engage in ***weekly and monthly reviews***, whenever possible. Such reviews increase the likelihood that information will be retained over time.

3. Making the Structure of the Lesson Presentation Explicit

Leinhardt's (1986) review indicated that effective teachers develop *specific instructional routines*, and the boundaries between the different segments of a lesson are well-defined. For example, effective teachers structure homework, drill, review, presentations, student practice, etc. into clearly defined segments of their lesson. As a result, students in the class are provided with consistency and structure, and seldom are lost.

Limitations/Barriers to Effective Use

1. *Need for Teacher Education in Explicit Teaching Techniques*

Explicit teaching necessitates that teachers have honed their skills in numerous areas including writing objectives, providing appropriate lecture structure, modeling, guided practice, etc. These skills may need to be taught at both the inservice and pre-service levels.

2. *Teacher Resistance to Change*

As Hermann (1990) noted, teachers may be resistant to change for a number of reasons. First, they have been educated in traditional school settings. Additionally, teachers may be unaware of the complexity in the reflective and reasoning processes involved in making teaching explicit and may be resistant to making the efforts needed for change.

Teaching Sameness

Principle 10: ***By teaching sameness both within and across subjects, teachers promote the ability of students to access potentially relevant knowledge in novel problem-solving situations.***

Research

- A study by Anderson and Smith (1984) illustrates the importance of teaching students *commonalties across various topics and types of problem-solving situations*. Several researchers, such as Kameenui (1991), Pea (1987), and Prawat (1989), indicated that educators should devote more attention to defining common elements both within and across subjects.

- Reid (1991) expressed concern regarding the extent to which our nation's schools fail to instruct students to solve problems flexibly. He stressed that traditional instruction presents skills in an isolated fashion, with little effort to teach students to use skills they learn in a versatile manner.

- Ways in which educators can assist learners to use the skills and knowledge they acquire in a flexible, coordinated manner are (a) by analyzing the curricula to determine commonalties (i.e., conducting "sameness analyses") and (b) by explicitly instructing students regarding these commonalties. By engaging in these two activities, teachers are promoting cognitive organization and flexible cognition. Consequently, when students are able to detect commonalities across various problem situations, they are able to access potentially relevant knowledge more readily and flexibly.

What is Teaching Sameness?

- According to Campbell (cited in Kameenui, 1991), a single concept can link many seemingly different ideas. Therefore, this single linking concept has great generality and power to assist students in seeing "... *the general in the particular*" (Mason, in Prawat, 1989). In other words, by providing students with numerous examples of structural sameness, students may begin to generalize through presentations or examples "of the particular" (Kameenui, 1991).

- By determining the commonalities within and across subjects, Englemann and Carnine (cited in Kameenui, 1991) proposed that educators could link different subjects (e.g., spelling, history, reading comprehension, etc.). As Kameenui (1991) proposed, the hidden grammar that links a wide range of complex concepts from vastly different topics is implicit in the "teaching of sameness." Through the identification of structural sameness within and across subjects, teachers can (a) eliminate students uncertainty about a new and relatively unknown topic, (b) assist students in making associative links in their cognitive structures, and (c) teach more in less time (Kameenui, 1991).

Research (continued)

Rationales for Teaching Sameness Across Subject Matter and Curricula

A. Developmental Considerations in Teaching Sameness

- According to Chi (1985), one robust developmental finding regarding the organizational capabilities of young children is that their inability to recall is related to *inefficient strategy organization.* Chi noted that there appears to be among young children an absence of the taxonomic categorical clustering strategies that characterize the adult population. Whereas as adults often categorize according to superordinate and subordinate variables, young children's categories tend to be organized on the basis of such features as perceptual similarity and concrete association. Additionally, results of a series of studies conducted by Chi (1985) revealed the additional findings: (a) young children's categorical knowledge sets are *fewer in number* with a more restricted set of core or central members, and (b) young children are capable of sorting and categorizing items into their taxonomic categories *when explicitly requested to do so.* Needless to say, the immature manner in which children go about the task of categorizing results is inefficient organization, and ultimately, limited ability to access relevant information in potentially relevant situations.

- Loper (1980) concluded that young children appear to be less able to differentiate the essential from non-essential aspects of a task. Taken together with Chi's (1985) findings, it seems that teachers can do much in facilitating the manner in which children organize their knowledge. By assisting children in seeing both the *similarities* and *differences* across various topics and content material, teachers are increasing the likelihood that students, especially younger ones, are organizing their knowledge in a more efficient and effective manner.

B. Teaching Sameness Helps Students to Recognize Patterns and Organize Knowledge

- "Teaching sameness" across subject matter and curricula assists students to recognize patterns both within and across content areas. Studies involving both children (Chi, 1978) and adults (de Groot, 1965,) have suggested that expert learners appear to be superior to novices or ineffective learners in their ability to recognize basic "*problem types or patterns.*" This superior knowledge also appears to play an important role in guiding the strategies experts employ during problem solving.

- Chi (1978) and de Groot (1965) have suggested that experts *organize* their knowledge differently from novices or ineffective learners. Whereas novices group problems or patterns in terms of *specific, concrete features*, experts appear to group information according to more *abstract principles.*

- The superior manner in which experts organize their knowledge of problem types or patterns appears to be, at times, even more important than the *extent* of one's knowledge base (Polya, in Prawat, 1989). As addressed in the two preceding effective teaching principles, key ideas or understandings are represented within the cognitive system as *associative links* or *relations.* Accessibility of knowledge, then, is a function of the strength of these associative links or relations. Seeing the interrelationships among units of knowledge, according to Prawat (1989), is the *sine qua non* of conceptual understanding. Consequently, by teaching sameness both within and across subject matter, teachers provide students with the means to make stronger associative links in their cognitive structures. As Prawat (1989) noted, effective teachers present information in such a way that students are able to make the associative connections and integrate it with, and differentiate it from, what they already know. Fostering this kind of connectedness contributes to the flexible accessing of relevant knowledge in diverse problem-solving situations.

- Teaching sameness helps students to organize knowledge by fostering *relational understanding.* Understanding the interrelationships among various problem situations, enables students to remember them as parts of a whole (Prawat, 1989). Though more difficult to learn, relational understanding is potent in terms of long-term memory storage and flexible accessing (Prawat, 1989).

Research (continued)

- Prawat (1989) maintained that various domains (e.g., mathematics, reading, social studies) are comprised of *"key ideas"* that form the basic building blocks for understanding. Findings from Leinhardt's (1989) study suggest that provision of key ideas may enhance student learning.

Teaching Techniques to Incorporate Sameness

- As Kameenui (1991) asserted, little progress has been made in recognizing the structural sameness embedded within curricula. In his seminal article, Kameenui identified two reasons why creating "sameness" within the curriculum is important. First, by conducting a "sameness analysis" of the curriculum, teachers can teach more content in less time. Second, the structural sameness allows students to acquire building blocks essential to the development of complex cognitive structuring.

- Both analogies and metaphors have been researched extensively and are effective techniques for assisting students to transfer information from a known domain to a new one (cf. Prawat, 1989). They are effective techniques to facilitate the development of new schemata and to promote recall. These techniques appear to be particularly effective when (a) they are explicitly used as cues to prompt recall, and (b) two or more analogies/metaphors are used to illustrate a specific concept, and (c) when students are provided with multiple opportunities to use analogies and metaphors to solve problems (Glick & Holyoak, 1983; cf. Glover, Ronning, and Brunning, 1990).

- As Glover, Ronning and Brunning (1990) concluded in their review, many students (including college students) do not *spontaneously generate* analogies and metaphors in problem-solving situations. Therefore, students may need to be prompted to use the analogy/metaphor to help solve a relatively similar, yet still novel problem. Also, the use of multiple analogies and metaphors to illustrate structural sameness appears to help students to utilize relevant knowledge in future problem-solving situations. Of utmost importance is that students be provided with ample opportunities to solve structurally similar problems so that transfer is enhanced. Teachers can facilitate transfer of knowledge necessary for problem solving by pointing out features of the problem situation that if present in future situations, would suggest further utilization of the same information (Prawat, 1989). Finally, Gick and Holyoak (1983) promoted transfer by having individuals produce written comparisons or visual representations that highlight common and important features across analogous situations.

Limitations/Barriers to Effective Use

1. Conducting Sameness Analyses is a Difficult and Time-Consuming Task

Identifying sameness across curricula is at best a time-consuming, laborious process. This would require that educators and curriculum developers spend considerable time determining structural sameness across topics and designing and developing the curriculum in a manner to facilitate teaching of sameness in coherent, meaningful ways. Educators and curriculum developers would have to possess an in-depth understanding of the curricula in their respective domain(s) of expertise (e.g., social studies, social, mathematics), and identify sameness in domains outside their realm of expertise. As Kameenui (1991) noted, structural sameness includes the identification of structural differences and misconceptions, too. With these limitations in mind, educators and curriculum developers must have both ample training and time to undertake the comprehensive analysis that would be required to conduct a sameness analysis.